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PREVALENCE OF ASTIGMATISM AMONG AVIATORS AND ITS LIMITING EFFEC--ETC(U)

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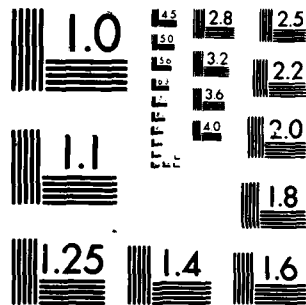
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PREVALENCE OF ASTIGMATISM AMONG AVIATORS AND ITS LIMITING EFFECT UPON
VISUAL PERFORMANCE WITH THE AN/PVS-5 NIGHT VISION GOGGLES

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Introduction. Emphasis on sustained operations during periods of darkness is steadily increasing. Presently, the AN/PVS-5 Night Vision Goggles (NVG) (Fig. 1) are utilized for night operations. The primary concern with these goggles is the astigmatism criterion since this, unlike spherical refractive errors, is not compensated by the NVG.

of an American Optical projector. After completely darkening the room and eliminating all extraneous light sources, the subject was instructed to turn on the NVG and uncover one viewing port, alternately adjusting the NVG focusing and dioptric control rings to obtain the sharpest resolutions for each eye. The appearance to the subject is approximated in Fig. 2. After the monocular visual acuity was obtained, the interpupillary distance was adjusted for the binocular test.



Figure 1

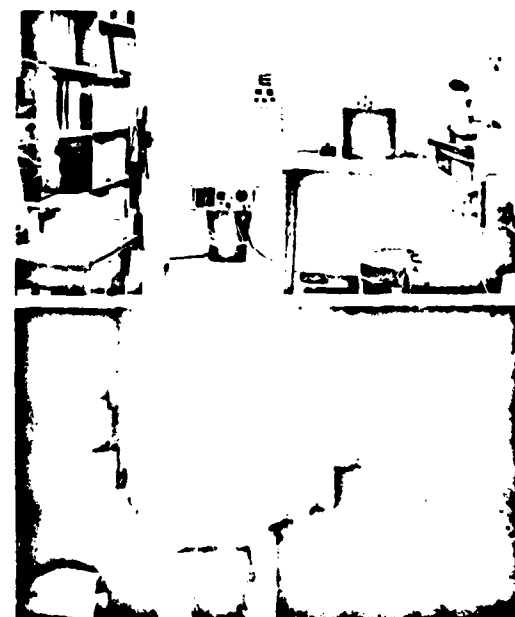


Figure 2

The NVG have only an adjustable range of +2.00 to -6.00 diopters to correct for spherical error. No provisions were incorporated into the design of the NVG to allow correction of astigmatic error. Consequently, an aviator with a significant amount of astigmatism will have reduced visual acuity which will affect his operational performance. A study was undertaken to identify the number of rated aviators at the Army Aviation Center with detected astigmatism in order to assess the magnitude of this particular problem and to determine whether or not the current standards for astigmatism are sufficient for the aviators who are using the AN/PVS-5 Night Vision Goggles.

Methods. Two types of survey data were obtained. Medical records of all 850 rated aviators at the Aviation Center were reviewed. For aviators requiring corrective lenses, the following information was obtained: date of birth, sex, date of initial physical exam and refractive error, latest refractive error and date, and visual acuity at distance and near during these exams. The astigmatic component and nature of the astigmatism were categorized. Next, twenty-seven aviators with various amounts and types of astigmatism were given monocular and binocular visual acuity tests through the NVG under a simulated night condition which was generated by placing two Wratten gelatin filters, ND 4.00 and ND 0.80, in front of the objective lens

Results and Discussion. Of the 850 surveyed, 146 aviators (17.2%) were required to wear spectacles during flight. The frequency distribution of their cylindrical components is shown in Table 1. Symmetry of both eyes was very common, but unilateral astigmatism was found in 32% of the cases. In 68% of the astigmatic cases the axis was located within vertical meridians. Twenty-one percent of the astigmatics fell within the horizontal meridians, and 11% fell in the oblique axes. Of all 850 pilots, 31 (3.6%) had an astigmatism greater than 1 diopter. In general, it was found that one diopter of astigmatism is the level at which monocular visual acuity through the NVG begins to deteriorate. It is important to note that, except for the aviators having oblique axes, all subjects with 1 diopter or less of astigmatism were able to read binocularly most of the 20/50 letters through the NVG. For a given amount of

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astigmatism, visual acuity was generally better when the axis of the error was horizontal or vertical rather than oblique (see Table 2).

Table 1. Cylindrical Component
(# Eyes = 292)

| Amount of Astigmatism | Number of eyes |
|--------------------------|-------------------|
| 0.00 | 99 |
| 0.25D | 45 |
| 0.50D | 58 |
| 0.75D | 39 |
| 1.00D | 24 |
| 1.25D | 8 |
| 1.50D | 12 |
| 1.75D | 1 |
| 2.00 | 4 |
| 2.25 | 0 |
| 2.50 | 0 |
| 2.75 | 2 |

Table 2. Mean monocular visual acuity
through NVG

CYLINDRICAL POWER

| Axis of Astigmatism | -0.50D | -0.75D | -1.00D | -1.25D | -1.50D |
|--|---------|---------|---------|---------|---------|
| Horizontal (0-30) (150-180) | 20/50-1 | 20/50-1 | 20/60+2 | 20/60-1 | 20/70-2 |
| Vertical (60-120) | 20/50-1 | 20/60+1 | 20/60 | 20/60-3 | 20/70-3 |
| Oblique (120-150) and (30-60) | 20/60+1 | 20/60-1 | 20/70+1 | 20/80+1 | 20/100 |

The Aviator Night Vision Imaging System (ANVIS), which is expected to be available to the field by late 1983 (see Fig. 3), will not correct astigmatic error. The ideal solution is to provide a means for correction of astigmatic error while wearing the NVG. Four approaches have been considered:

- modifying the pads of the NVG to accommodate spectacles;
- fitting aviators with front toric "soft" contact lenses;
- developing an optical outsert to be attached to the NVG;
- creating a separate visual standard for NVG wearers.

Modifying the pad simply involves cutting away part of the pad on each side of the NVG mask. This procedure seems to accommodate aviator spectacles and combat spectacles. A preliminary field study indicated that both spectacles caused some discomfort at the bridge of the nose. Additionally, the aviator spectacles caused discomfort at the eye wire.

Front toric "soft" lenses presently available do not resolve or correct astigmatic errors adequately, and they are not logistically feasible.

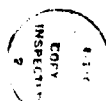
A simple cylindrical lens outsert on the NVG to correct astigmatism would not be practical because the rotation of the eye lens associated with a dioptric adjustment would change the axis of the cylindrical lens.



Figure 3

Consideration of a stricter standard does not seem necessary since the present standard already limits astigmatism to 0.75 diopters. The 3.6% of the aviator population having astigmatism greater than 1 diopter may require the wearing of spectacles or the development of a stabilized outsert which will not rotate with the eye-piece lens. Finally, this astigmatic problem needs to be further investigated using modulation transfer function or contrast sensitivity as measurement criteria.

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